

REMARKS/ARGUMENTS

Claims 1, 2, and 11-13 are cancelled and claims 20 and 21 are added. Claims 3 to 10 and 14 to 21 are now active.

Claim 3 is rewritten to be in independent form and to include the content of original claims 1 and 2, from which it originally depended. It thus recites the catalyst ruthenium content.

Claim 6 is amended to recite the content of ruthenium in the catalyst and to replace “of” with “comprising”.

Basis for the ruthenium content recitation is to be found in the paragraph bridging pages 12 and 13.

The remaining claims depend directly or indirectly from claims 3 or 6.

New Claim 20 corresponds to previous Claim 15.

THE DETAILED ACTION

Reconsideration and withdrawal of the rejection of claims 4 and 5 under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention are requested. Claims 4 and 5 now refer to claim 3, where antecedent basis for the criticized article “the” occurs.

Reconsideration and withdrawal of the rejection of claim 15 under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention are requested. It was noted that claim 15 states “the catalyst of claim 6” while claim 6 is drawn toward a method of production. As amended, claim 15 now refers to claim 5, where a catalyst is defined.

Reconsideration and withdrawal of the rejection of retained claims 4-10 and 14-19 under 35 U.S.C. § 103(a) as being obvious over Yashushi (JP 09-131531) are requested.

Since claims 4, 5, 8, 9, 10, 14, 15, 16 and 18 depend directly or indirectly solely on claim 3, as to which Yasushi was not applied, it would appear that those claims are free of the rejection.

As for claim 6 and claims 7, 20 (new) and 21 (new), dependent directly or indirectly thereon, reconsideration is requested for the following reasons.

Applicants observe the following:

The object of the present invention is to provide a CO oxidation catalyst which is effective for selectively oxidizing and removing CO from a hydrogen-containing gas in a broad reaction temperature range, especially even at relatively high temperatures; to provide a method for producing the catalyst; and to provide a method of using the catalyst for producing a hydrogen-containing gas, especially for producing a hydrogen-containing gas favorable to fuel cells, note the paragraph at line 12 on page 24.

Yasushi discloses nothing definite about a combination of titania and alumina for the carrier of the catalyst. In addition, the reference contains no suggestion that the catalyst with a carrier of titania and alumina combined is significantly superior to the catalyst with a carrier of titania or alumina alone.¹

The advantage of the present invention are evident from Comparison between the Examples and the Comparative Examples.

The reaction temperature range within which the [CO] was reduced to at most 10 ppm was determined. Please see Table 3, page 39. The results for Example 11 and Comparative Example 5 are there tabulated.

¹ While there is a disclosure that "at least one" (in paragraph [0013]; in view of the Abstract) of the itemized inorganic oxide supports that may be chosen, there is no specific example of a combination. The reference here is to the translation.

The higher limit of the reaction temperature range is 300°C in Catalyst 1 and 2 (Example 11), while it is 200°C in Catalysts 7 and 250°C in Catalysts 9 (Comparative Example 5). This temperature difference of 50°C or 100°C is extremely important.

The results for the CO concentration in the processed gas brought about the Catalysts in each temperature (200°C, 250°C, 300°C) are shown in the following table here supplied. It is evident that the CO concentration in the gas processed with Catalysts 7 and 9, which do not comprise a combined titania-alumina-carrier, increases at a faster rate beyond 200°C or 250°C. That is, Catalysts 7 and 9 are lacking in practicality for fuel cells.

CO concentration (ppm) in the processed gas

Catalyst	TiO ₂ /Al ₂ O ₃ (by weight)	Ruthenium (wt%)	Potassium (wt%)	200°C (ppm)	250°C (ppm)	280°C (ppm)	300°C (ppm)
Catalyst 1	80/20	1.0	0.1	0	0	3	10
Catalyst 2	50/50	1.0	0.1	0	0	3	10
Catalyst 7	100/0	1.0	0.1	10	1100	--	--
Catalyst 9	0/100	1.0	0.1	1	10	120	900

Clearly, the TiO₂-alumina combination exhibits significant advantages not to be deduced from the reference. Hence, the reference does not guide one to the claimed invention.

Reconsideration and withdrawal of the rejection of retained claim 3 under 35 U.S.C. § 103(a) as being obvious over Nishino et al. (USPN 4350613) are requested.

Claim 3, as here amended, contain the alkali metal-alkaline earth metal recitation, present in deleted claim 2, as to which Nishino et al. was not applied.

Hence, it would appear that the here amended claim 3 avoids Nishino et al.

Moreover, Nishino et al. disclose calcium aluminate, not alumina, at the locations noted.

Reconsideration and withdrawal of the rejection of claim 11 under 35 U.S.C. § 103(a)
as being unpatentable over Yasushi as applied to claim 2 above, and further in view of
Nishino et al. applied to claim 3 above, are also requested.

In Applicants' view, the references are inappropriately combined for the reasons that follow.

The processed gas of the present invention (see for instance, Table 2, page 38, Example 11) consists of 74.4% of hydrogen, 0.6% of carbon monoxide, 15% of carbon dioxide, 2% of oxygen and 8% of nitrogen. To prevent poisoning and deterioration of platinum-type electrode catalysts in fuel cells, it is desirable that the CO concentration in the fuel gas be lowered generally to at most 100 ppm, preferably to at most 10 ppm. The present invention is intended to solve the very difficult problem.

In contrast, Nishino et al. relates to a catalyst for purifying exhaust gases generated from burning or cooking appliances such as petroleum stoves or heaters. The processed gas of the invention of Nishino et al. comprise a large amount of carbon dioxide and a little amount of carbon monoxide (300 ppm in Example, col. 9, last paragraph, col. 12, par. at line 40, col. 15, par. at line 30), and does not contain hydrogen. Therefore, the technical problem of Nishino et al. for reducing the CO concentration of the gas is not more difficult than that of the present invention.

The processed gas of a wick up-and-down type petroleum stove has generically a ratio of CO to CO₂ content of $\text{CO/CO}_2 = (4-9) \times 10^{-4}$, and the CO concentration in the gas is inherently low. The processed gas contain generically about 60 - 350 ppm of hydrocarbons. The processed gas of a kerosene fan heater has generally a ratio of $\text{CO/CO}_2 = (3-4) \times 10^{-4}$, and the CO concentration in the gas at the time of ignition is about 30-80 ppm.

A very low CO concentration is to be expected in these burners for home use in view of the known harmful character of CO.

Thus, the present invention is quite different from that in Nishino et al. in the kinds of processed gas for application and in the difficulty level of the technical problem.

In addition, in case fuel gas contains a large amount of hydrogen, when CO in fuel gas is oxidized, hydrogen therein is also generally oxidized. Therefore, if catalyst whose selectivity for CO conversion is low are used for reducing CO in fuel gas, the usability of the fuel gas is lowered because the large amount of hydrogen is sacrificed through oxidation.

That is, the technical problem of the present invention for removing CO selectively from a hydrogen-rich, CO-containing gas is very high and quite different from that addressed by Nishino et al.

Hence, the chemical problem addressed by Yasushi, and by Applicants, is different from that with which Nishino et al. are concerned, and the Nishino et al. disclosures are not appropriately combined with Yasushi to defeat the subject invention.

Furthermore, Nishino et al. do not disclose alumina as such in their carrier at the locations, col. 4, line 57 to col. 5, line 1, and col. 5, lines 50-52. They disclose calcium aluminate, which is not alumina, compare the subject application, in the paragraph bridging pages 10 and 11 and Nishino et al. at col. 7, paragraphs at lines 18 and 33.

For the reasons given, favorable reconsideration of the claims, as here amended, are requested.

Respectfully Submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER, & NEUSTADT, P.C.



Norman F. Oblon
Attorney of Record
Registration No.: 24,618



22850

Tel.: (703) 413-3000
Fax: (703) 413-2220

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Milton Stermann
Registration No.: 27,499